

PHEV battery performance

Ron Gremban, CalCars, 2/16/2006

Blue = calculated Red = guessed

Last update: 2/23/2006 updated Firefly

Vehicle #	1	2
Vehicle	PRIUS+	FEH (Ford Escape hybrid)
Average battery consumption Wh/mi	210 (measured)	315 (est)
Average grid consumption Wh/mi	262 (measured)	393 (est)
Average EV during PHEV %	50% (100% up to 34 mph)	100% (assuming ability to change hybrid SW)
Max. PHEV cruise disch. kw	7.1 (35.5A@200V@34mph)	22.1 (74A @ 300V@70mph)
Max. discharge rate A	200	265 (70 kW @ 264V)
Max. charge rate A	120	69 (25 kW @ 360V)
OEM # of cells, nominal V	168 202V	250 300V
OEM max charge V	270	400
OEM min EV voltage V	180	200
OEM internal resistance milliohms	350	1000 (165V @ 165A)
Weight of OEM cells kg	28.3 (62 lb)	45.5 (100 lb)
Max. DC internal resistance milliohms	350	500 (132V @ 265A)
Desired max. DC int. res. milliohms	200	250 (66V/20% @ 265A)
Minimum est. calendar life years	10	10
Minimum est. cycle life cycles	3650	3650

*Chg hr: Hours required to charge at 1.5kW; includes 3 hr (8 hr for PbA) for battery-required taper and overcharge

**Ah Amp-hr capacity at maximum PHEV cruise discharge rate (see row 8 above)

===== PHEV =====																																		
Battery	Chem	Vehicle	DOD	Range	Chrg	Added wt	===== Cells =====					===== Modules =====							Vol L	Nom V	Max V	Ah	kWh	===== Max C =====			Vsag %C	int. res. mOhm	Est. \$/kW	Est. \$	V #			
							mi	hr*	kg	lb	series	per N.V	MxV	Ah**	series	II	total	NomV						MxV	mOhm	gm						Wh/kg	mL	accel
Desired ->																																		
Generic, 250 Wh/L	Li-ion	PRIUS+	60%	40.0	5.8	41.7	92	64	1	3.7	4.20	29.6	64	1	64	3.7	4.2	3.1	1094	100	438	28	237	269	29.6	7.0	6.8	1.7	4.1	2.5%	200	500	\$3,500	1
Generic, 250 Wh/L	Li-ion	PRIUS+	60%	60.0	7.2	76.7	169	64	1	3.7	4.20	44.3	64	1	64	3.7	4.2	3.1	1641	100	656	42	237	269	44.3	10.5	4.5	1.1	2.7	3.7%	200	500	\$5,250	1
Enax	Li-ion	PRIUS+	60%	44.9	6.1	30.6	67	64	1	3.7	4.20	8.3	64	4	256	3.7	4.2	4.5	230	134	147	38	237	269	33.2	7.9	6.0	1.5	3.6	1.0%	72	600	\$4,717	1
Enax	Li-ion	PRIUS+	60%	67.4	7.7	60.0	132	64	1	3.7	4.20	8.3	64	6	384	3.7	4.2	4.5	230	134	147	56	237	269	49.8	11.8	4.0	1.0	2.4	1.0%	48	600	\$7,076	1
Enax	Li-ion	PRIUS+	60%	89.8	9.3	89.5	197	64	1	3.7	4.20	8.3	64	8	512	3.7	4.2	4.5	230	134	147	75	237	269	66.4	15.7	3.0	0.8	1.8	1.0%	36	600	\$9,434	1
Saft LV41M-6S	Li-ion	PRIUS+	60%	57.2	7.0	59.7	131	66	6	3.7	4.20	41.0	11	1	11	22.2	25.2	22.0	8000	114	5660	62	244	277	41.0	10.0	4.9	1.2	2.9	4.1%	242	1000	\$10,012	1
Worley 100216216HP	Li-ion	PRIUS+	60%	54.1	6.8	42.1	93	64	1	3.7	4.20	40.0	64	1	64	3.7	4.2	4.6	1100	135	480	31	237	269	40.0	9.5	5.0	1.3	3.0	4.9%	292	600	\$5,683	1
Worley 60460330HP	Li-ion	PRIUS+	60%	94.7	9.6	96.5	212	64	1	3.7	4.20	70.0	64	1	64	3.7	4.2	2.7	1950	133	860	55	237	269	70.0	16.6	2.9	0.7	1.7	5.1%	171	600	\$9,946	1
Valence U1-12XP	Li-ion	PRIUS+	60%	52.7	6.7	79.7	175	72	4	3.2	3.75	40.0	18	1	18	12.8	15.0	16.0	6000	85	4837	87	230	270	40.0	9.2	5.0	1.3	3.0	5.0%	288	1000	\$9,216	1
Early Firefly	PbA+	PRIUS+	75%	52.5	6.7	265.5	584	108	6	2.0	2.45	34.0	18	1	18	12.0	14.7	10.0	16320	25		0	216	265	34.0	7.3	5.9	1.3	3.5	2.8%	180	350	\$2,570	1
Advanced Firefly	PbA+	PRIUS+	75%	55.5	6.9	127.2	280	108	6	2.0	2.45	36.0	18	1	18	12.0	14.7	10.0	8640	50		0	216	265	36.0	7.8	5.6	1.2	3.3	3.0%	180	250	\$1,944	1
Evercel improved MB40	NiZn	PRIUS+	75%	59.2	7.1	115.7	255	144	8	1.6	2.00	36.0	18	1	18	12.8	16.0	10.0	8000	58	4720	85	230	288	36.0	8.3	5.6	1.1	3.3	2.8%	180	300	\$2,488	1
Generic, 87 Wh/L	NiMH	PRIUS+	75%	40.0	5.8	96.1	212	180	1	1.2	1.50	25.9	180	1	180	1.2	1.5	1.1	691	45	358	64	216	270	25.9	5.6	7.7	1.7	4.6	2.4%	200	500	\$2,800	1
Electro Energy	NiMH	PRIUS+	75%	46.3	6.2	104.5	230	180	60	1.2	1.44	15.0	3	2	6	72.0	86.4	138.0	22133	49	8000	48	216	259	30.0	6.5	6.7	1.5	4.0	2.9%	207	500	\$3,240	1
Toyota OEM (4x)	NiMH	PRIUS+	75%	37.4	5.6	89.3	196	168	6	1.2	1.60	6.5	28	4	112	7.2	9.6	12.5	1050	45	593	66	202	269	26.0	5.2	7.7	1.8	4.6	1.1%	88	1100	\$5,766	1
EV-1	NiMH	PRIUS+	75%	143.3	13.0	292.5	644	176	11	1.2	1.50	95.0	16	1	16	13.2	16.5	6.9	20050	63	7876	126	211	264	95.0	20.1	2.1	0.5	1.3	5.0%	110	250	\$5,016	1
Generic, 50 Wh/L	PbA	PRIUS+	75%	20.0	9.4	111.7	246	114	6	2.0	2.40	12.3	19	1	19	12.0	14.4	10.5	7368	20	2947	56	228	274	12.3	2.8	16.3	3.4	9.8	1.1%	200	300	\$840	1
BB Battery EVP20-12	PbA	PRIUS+	75%	19.5	9.4	95.2	209	114	6	2.0	2.45	12.0	19	1	19	12.0	14.7	25.0	6500	22	2286	43	228	279	12.0	2.7	16.7	3.5	10.0	2.5%	475	290	\$793	1
Odyssey PC625	PbA	PRIUS+	75%	19.5	9.4	85.7	189	114	6	2.0	2.45	12.0	19	1	19	12.0	14.7	25.0	6000	24	2946	56	228	279	12.0	2.7	16.7	3.5	10.0	2.5%	475	330	\$903	1
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							mi	hr*	kg	lb	series	per N.V	MxV	Ah**	series	II	total	NomV						MxV	mOhm	gm						Wh/kg	mL	accel
Desired ->																																		
Generic, 250 Wh/L	Li-ion	FEH	60%	20.0	7.2	59.5	131	96	1	3.7	4.20	29.6	96	1	96	3.7	4.2	2.6	1094	100	438	42	355	403	29.6	10.5	9.0	3.5	2.3	2.1%	250	500	\$5,250	2
Generic, 250 Wh/L	Li-ion	FEH	60%	30.0	9.3	112.0	246	96	1	3.7	4.20	44.3	96	1	96	3.7	4.2	2.6	1641	100	656	63	355	403	44.3	15.8	6.0	2.3	1.6	3.1%	250	500	\$7,875	2
Generic, 250 Wh/L	Li-ion	FEH	60%	40.0	11.4	164.5	362	96	1	3.7	4.20	59.1	96	1	96	3.7	4.2	2.6	2188	100	875	84	355	403	59.1	21.0	4.5	1.8	1.2	4.2%	250	500	\$10,500	2
Generic, 250 Wh/L	Li-ion	FEH	60%	60.0	15.6	269.5	593	96	1	3.7	4.20	88.7	96	1	96	3.7	4.2	2.6	3281	100	1313	126	355	403	88.7	31.5	3.0	1.2	0.8	6.2%	250	500	\$15,750	2
Enax	Li-ion	FEH	60%	22.5	7.7	42.8	94	96	1	3.7	4.20	8.3	96	4	384	3.7	4.2	4.5	230	134	147	56	355	403	33.2	11.8	8.0	3.1	2.1	1.0%	108	600	\$7,076	2
Enax	Li-ion	FEH	60%	33.7	10.1	87.0	191	96	1	3.7	4.20	8.3	96	6	576	3.7	4.2	4.5	230	134	147	85	355	403	49.8	17.7	5.3	2.1	1.4	1.0%	72	600	\$10,613	2
Enax	Li-ion	FEH	60%	44.9	12.4	131.1	289	96	1	3.7	4.20	8.3	96	8	768	3.7	4.2	4.5	230	134	147	113	355	403	66.4	23.6	4.0	1.6	1.0	1.0%	54	600	\$14,151	2
Saft LV41M-6S	Li-ion	FEH	60%	27.7	8.8	82.5	182	96	6	3.7	4.20	41.0	16	1	16	22.2	25.2	22.0	8000	114	5660	91	355	403	41.0	14.6	6.5	2.5	1.7	4.1%	352	1000	\$14,563	2
Worley 100216216HP	Li-ion	FEH	60%	27.1	8.7	60.1	132	96	1	3.7	4.20	40.0	96	1	96	3.7	4.2	4.6	1100	135	480	46	355	403	40.0	14.2	6.6	2.6	1.7	4.9%	438	600	\$8,525	2
Worley 60460330HP	Li-ion	FEH	60%	47.4	12.9	141.7	312	96	1	3.7	4.20	70.0	96	1	96	3.7	4.2	2.7	1950	133	860	83	355	403	70.0	24.9	3.8	1.5	1.0	5.1%	256	600	\$14,918	2
Valence U1-12XP	Li-ion	FEH	60%	26.3	8.5	116.5	256	108	4	3.2	3.75	40.0	27	1	27	12.8	15.0	16.0	6000	85	4837	131	346	405	40.0	13.8	6.6	2.7	1.7	5.0%	432	1000	\$13,824	2
Early Firefly	PbA+	FEH	75%	26.2	8.5	395.1	869	162	6	2.0	2.45	34.0	27	1	27	12.0	14.7	10.0	16320	25		0	324	397	34.0	11.0	7.8	2.7	2.0	2.8%	270	350	\$3,856	2
Advanced Firefly	PbA+	FEH	75%	27.8	8.8	187.8	413	162	6	2.0	2.45	36.0	27	1	27	12.0	14.7	10.0	8640	50		0	324	397	36.0	11.7	7.4	2.5	1.9	3.0%	270	250	\$2,916	2
Evercel improved MB4																																		